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Case Report

Acute Limb Ischemia: An Uncommon Complication of Long Bone Fracture

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Abstract

Introduction: Vascular injuries associated with limb bone fractures are surprisingly uncommon, with a reported incidence of less than 3% [1]. When these injuries occur, there is a threat to the life of the affected limb and the patient. Delay in diagnosis of concomitant vascular trauma is the leading cause of amputation in this limb-threatening (and life-threatening) injury.

Case Report: A 52-year-old victim of a pedestrian-motor vehicle crash was brought to our emergency room about an hour after the incident. History, tests, and imaging corroborated the diagnosis, and treatment ensued. The result 6 months later is of a well-perfused, sensate left leg and foot with good motor functions; the contralateral tibia/fibular fracture has also shown good union, and he is currently undergoing rehabilitation on an outpatient basis.

Discussion: The mechanism of vascular injury caused by blunt trauma involves vascular occlusion secondary to thrombi of the ruptured vascular intima [3]. The threat in this setting is not only to the life of the affected limb but also to the injured individual's life. Therefore, in managing vascular injuries associated with fractures, the principles of resuscitation, early and accurate diagnosis, revascularization, soft tissue preservation, and fracture stabilization should be pursued as much as possible. Physical findings of hard signs of arterial injury are usually sufficient for preoperative diagnosis. However, angiography becomes necessary in cases of uncertain presence of distal pulse and especially in cases of blunt trauma. Classical angiography, however, leads to 1 – 2 hours of wasted time and may lead to the aggravation of ischemic severity. Single shot angiography in the operating room avoids such wasting of time.

Conclusion: A limb fracture with concomitant arterial injury puts the life of the limb and the patient at significant risk. The gross features of distal ischemia in a patient with a limb fracture should alert the clinician immediately to potential associated arterial injury, allowing for prompt resuscitation, evaluation, and repair—often without further diagnostic tests.

Keywords: *Amputation; Compartment Syndrome; Popliteal Fossa; Vascular Injury*

Introduction

Vascular injuries associated with limb bone fractures are surprisingly uncommon, with a reported incidence of less than 3% [1]. When these injuries occur, there is a threat to the life of the affected limb and the patient. Hence, amputation and mortality rates are primary outcome measures in managing these injuries [2].

Injury to the popliteal vessels has been recognized as one of the most limb-threatening peripheral vascular injuries so far as vascular trauma has been studied. This threat is due to the popliteal artery as a true-end artery with a tenuous collateral supply, while the popliteal vein provides the bulk of leg and foot drainage [2].

Delay in the diagnosis of concomitant vascular trauma is the leading cause of amputation in this limb-threatening injury. Failure to revascularize within 6 – 8 hours results in unacceptably high amputation rates (ARs) [3]. AR was 72% in World War II, decreasing to about 32% in the Korean and Vietnamese wars, owing to the development of vascular surgery techniques [4].

The most recent literature on this subject consists of case reports [1]. Despite this lack of large-scale studies, the management of extremity arterial injuries has evolved [5].

The decrease in amputation rates has been more for penetrating than for blunt trauma, about 8% and 38%, respectively, in a review of literature by McCabe., *et al*. (2001) [4].

We present the case of a 52-year-old man, a victim of a pedestrian-motor vehicle crash who was brought to our emergency room about an hour after the incident.

Case Presentation

A 52-year-old victim of a pedestrian-motor vehicle crash was brought to our emergency room about an hour after the incident. Initial assessment revealed the patient was lucid, hemodynamically stable, and had a left open distal femoral fracture. The ipsilateral leg was pale, cold, and pulseless with unrecordable oxygen saturation (spo2) on oximetry. The other three extremities were warm and pink. The initial radiographs revealed a posteriorly displaced supracondylar left femoral fracture.

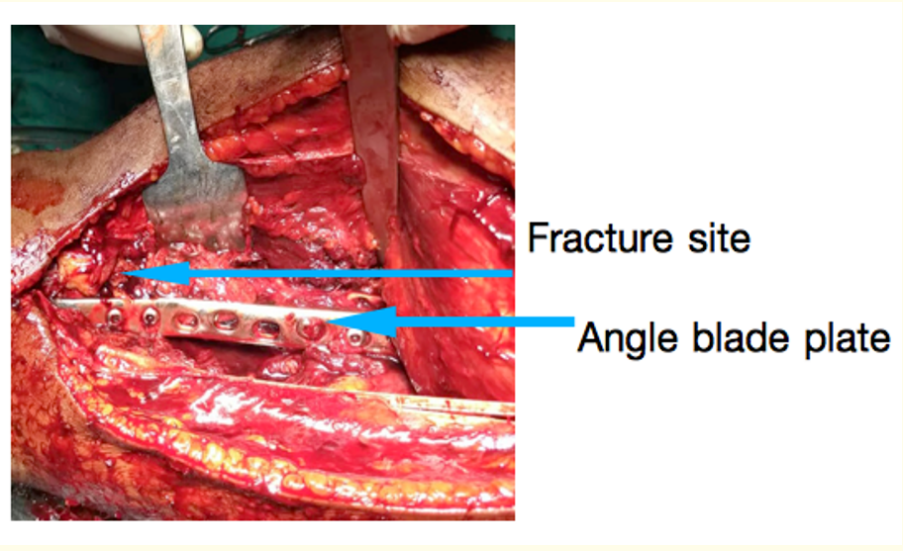

Figure 1: *Revealing the fracture site of the damaged knee.*

After an initial resuscitation, the orthopedic and cardiovascular surgery units carried out a joint operative intervention to fix the fracture and revascularize the limb using a bone-first approach. Systemic anti-coagulation was achieved with low dose unfractionated heparin given after the induction of general anesthesia and before the application of a proximal arterial tourniquet. The distal femur was approached via a lateral longitudinal incision, and after thorough saline irritation, the fracture was reduced and fixed with an angled blade plate.

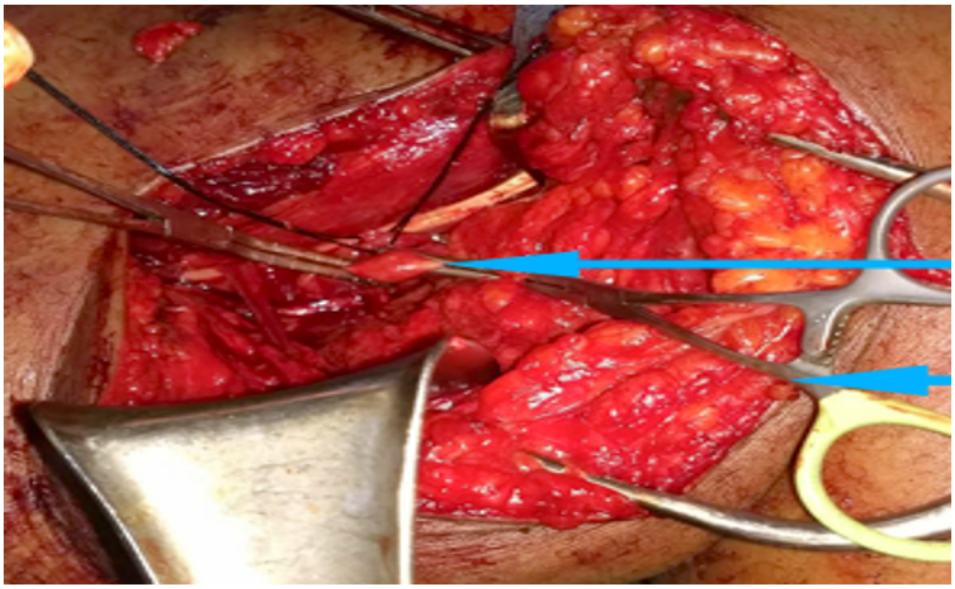

Figure 2: *Revealing the popliteal artery using pediatric vascular clamps.*

The wound was then overed with a sterile gauze and second longitudinal incision was made medially to expose the Popliteal vessels. After rapidly identifying the injured site and achieving proximal and distal control of the artery, the tourniquet was deactivated. The injured site was grossly bruised (but with intact adventitia), and no pulsation distally. An arteriotomy was performed, followed by Fogarty catheter thromboembolectomy, with yielded copious amounts of clot both proximally and distally. The vessel was then irrigated thoroughly with heparinized saline and the arteriotomy repaired. Wound repair was done in layers, leaving behind active drains.

The procedure was commenced about 4 hours after the injury and lasted about 90 minutes, with a tourniquet time of 60 minutes. Systemic anticoagulation was continued on the ward for the next 72 hours using subcutaneous heparin, 5000 units every 8 hours. Spo_2 in the early postoperative period was about 70%, increasing to 98% over the next 48 hours.

The result 6 months later is of a well-perfused, sensate left leg and foot with good motor functions; the contralateral tibia/fibular fracture has also shown good union, and he is currently undergoing rehabilitation on an outpatient basis.

Figure 3: *Surgical scar.*

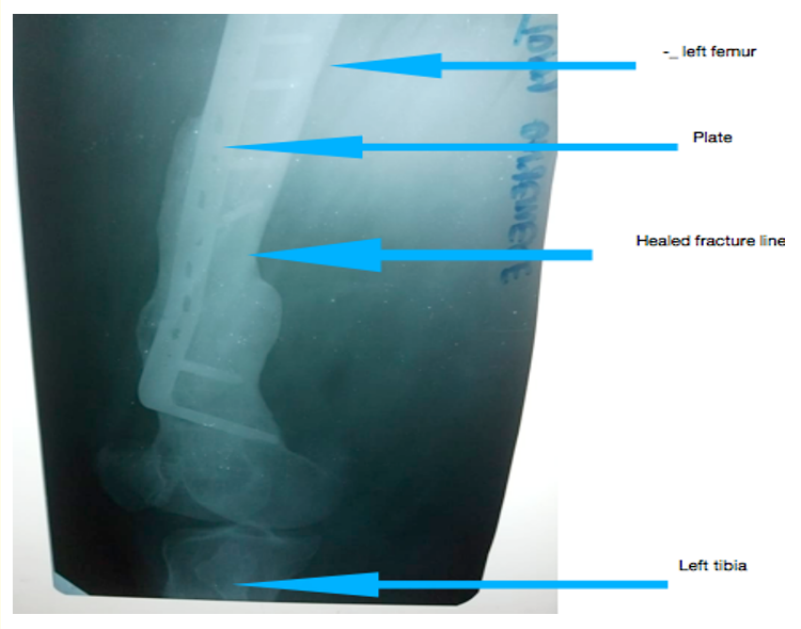

Figure 4: *Four-years follow-up radiograph.*

Discussion

Vascular injuries associated with limb fractures are usually caused by high-energy trauma [1]. The most common cause of vascular injuries in the extremity is generally penetrating trauma followed by blunt etiologies, such as traffic accidents and falls [3,4].

The mechanism of vascular damage caused by blunt trauma involves vascular occlusion secondary to thrombi of the ruptured vascular intima [3]. The threat in this setting is not only to the life of the affected limb but also to the injured individual's life. Therefore, in managing vascular injuries associated with fractures, the principles of resuscitation, early and accurate diagnosis, revascularization, soft tissue preservation, and fracture stabilization should be pursued as much as possible.

To this end, the airway must be protected, any bleeding should be stopped and blood and body fluid deficit should be corrected early in the care of these patients [4].

The diagnosis of associated vascular injury may be obvious or occult depending on the degree of damage to the vessel. This variation underlies the need for serial clinical examinations for at least 48 hours. A negative clinical examination does not reliably exclude vascular injury requiring surgery in patients with blunt trauma [3].

Physical examination—combined with Doppler pressure measurements and the combination of an ankle brachial pressure index of > 0.9 and a routine physical examination—can reliably exclude significant vascular injury [3].

On the other hand, physical findings of hard signs of arterial injury are usually sufficient for preoperative diagnosis. However, angiography becomes necessary in cases of uncertain presence of distal pulse and especially in cases of blunt trauma.

Classical angiography, however, leads to 1 – 2 hours of wasted time and may lead to the aggravation of ischemic severity. Single shot angiography in the operating room avoids wasting time [4].

The index patient showed definitive physical signs of distal ischemia. Thus, pursuing further imaging investigations would have unnecessarily increased the ischemia duration.

Early institution of systemic anticoagulation—once active bleeding has been ruled out—is recommended as it improves perfusion of the distal microcirculation, contributing to a reduction in the AR [3,5,6].

Some issues about the management of these injuries remain without consensus, such as 1) the ideal surgical sequence for the initial management of severe lower extremity injuries, and 2) whether or not aggressive attempts at salvage of severely injured lower extremities are in the eventual best interest of some patients (given the difficulty in predicting functional outcomes based on presenting injury characteristics) [5].

Some authors advocate the performance of vascular repair before bone stabilization to shorten the period of ischemia [6–8]. However, in early cases, obtaining a firm scaffold by initially fixing the fracture would facilitate vascular repair, reducing the chances of injuring an already repaired vessel during subsequent manipulation of the fractured bone segments [4,7,8].

Temporary intraluminal shunts maintain distal perfusion while the fracture is fixed, followed by vascular repair, representing a rational compromise in this scenario.

Vascular procedures commonly performed include thromboembolectomy, primary repair, lateral suture, end-to-end anastomosis, and graft interposition, as indicated by the injury's nature, location, and severity. The autologous reversed saphenous vein graft is preferred to PTFE, displaying better long-term results [7,9].

The risk of compartment syndrome increases in the setting of vascular injury associated with orthopedic trauma when compared with isolated vascular injuries with ischemia-reperfusion alone [10]. Factors of soft tissue trauma, crush injury, and concomitant venous injury or occlusion are believed to be synergistic in bringing about such an increase [11].

It is recommended that the repair of concomitant venous injury be performed, keeping arterial repair open and preventing postoperative edema [6], which otherwise would contribute to the development of compartment syndrome, leading to microvascular thrombosis and muscular necrosis.

Fasciotomy of all four compartments prevents such complications when performed early [3,6]. Some authors have advocated prophylactic fasciotomy on high-risk patients, such as those with ischemia for more than 6 hours or with a concomitant venous injury.

While prophylactic fasciotomy—where indicated—can improve the chances of limb salvage. Unnecessary fasciotomies should be avoided as they come with increased infection rates and hospital stay durations [3].

The index patient required no venous procedure. There was no indication for fasciotomy before or after the vascular intervention.

Conclusion

A limb fracture with concomitant arterial injury puts the life of the limb and the patient at significant risk. The gross features of distal ischemia in a patient with a limb fracture should alert the clinician immediately to potential associated arterial injury, allowing for prompt resuscitation, evaluation, and repair—often without further diagnostic tests.

Conflict of Interest Statement

The authors declare that this paper was written without any commercial or financial relationship that could be construed as a potential conflict of interest.

Ethical Approval

The manuscript was read and approved by both authors.

Supplementary Note

A previous abstract (appreciably updated herein) was presented at the Joint Association of Surgeons of Nigeria and the Nigerian Surgical Research Society Meeting, Umuahia, Nigeria, in July 2018 [12].

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